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# SUBSTITUTE

# *REMPLACEMENT*

## SECTION is not Present

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## A B S T R A C T

A segmental mould for curing a pneumatic tire is described and is comprised of two opposed side wall moulding mould sections and a plurality of radially slidable tread moulding segments mounted on one of said sections. Each segment is spring biased radially outwardly of the section on which it is mounted and the other section carries a frusto-conical skirt for co-operation with the radially outer surfaces of the segments to close them radially inwardly against their spring bias during relative closing movement of the segments; the segments being movable radially outwardly under the influence of their springs upon separation of the mould sections. The complete segmental mould is extremely compact facilitating its installation in an existing cross-ply tire curing press whereby the press may be readily converted without modification thereto for the curing of radial tires.

This invention relates to a mould for curing and moulding a tire under heat and pressure.

Various types of moulding and curing presses are known in the art and may conveniently be categorized into two groups, namely those presses utilizing a two-part mould having opposed annular mould halves suitable for shaping and curing passenger size cross-ply tires and those presses utilizing segmental moulds having opposed annular mould sections together with radially movable tread moulding segments generally used for curing giant cross-ply and radial-ply tires.

The segmental type of mould has been developed for several reasons, an important one being that, in the curing of radial-ply tires, it is generally not practicable to further expand the tire radially after its location in the mould. A radial-ply tire generally includes two or more circumferential substantially inextensible belts or breaker layers above the carcass plies and, due to the inextensibility of such breaker layers, it has been necessary in the building of the tire to expand the carcass radially outwardly into contact with the breaker layers and tread rubber so that the green tire assumes a partially shaped configuration before its insertion in the mould. It is thus generally impractical to expand such partially shaped green tire radially outwardly when it is located in the mould and, in any event, the stiffened tread region of a radial-ply tire, when cured, would not release readily from a two-part mould during axial separation of the mould halves; the tendency being to tear the tread rubber during such mould separation.

On the other hand, the segmental mould overcomes the foregoing disadvantages inasmuch that the mould segments are moved radially inwardly to engage the tread region of the green tire rather than expanding the tire radially outwardly to contact

the mould. Also, after the tire has been cured, the tread moulding segments are withdrawn radially outwardly to free them from the moulded tire without relative axial movement relative thereto, whereby release of the mould segments is facilitated and likelihood of damage to the tread region of the tire is minimized.

However, the mechanism provided for permitting movement of the tread moulding segments radially inwardly and outwardly generally occupies space radially outwardly of the overall boundaries of the annular mould sections generally necessitating either the designing of a special curing press to accommodate the segmental mould or at least the modification of existing presses to achieve the same result.

It is a broad object of the present invention to provide a segmental tire mould which is readily adaptable for use in conventional existing curing presses without modification thereto and which may, at the same time, be utilized for the moulding of either cross-ply or radial-ply tires.

It is a further object to provide a segmental tire mould wherein the mechanism for actuating radial movement of the tread moulding segments is compact, facilitating ready installation of the mould in existing curing presses.

In accordance with the invention, there is provided a segmental tire mould for installation in a curing press and including a pair of opposed mould sections for moulding the side walls of a tire and a segmental centre mould section for moulding the tread region of a tire; one of said sections carrying the mould segments thereon for radial sliding movement relative thereto and the other said mould section carrying actuating means co-operable with th mould segments for moving them radially inwardly upon closing movement of said mould sections towards one anoth r; said mould segments being resiliently biased

dially outwardly of the mould section upon which they are mounted, whereby upon opening of said mould sections, said segments are movable radially outwardly of the mould by the biasing means.

In one form of the invention, the segments are carried by a stationary mould section and actuated for radially inward movement by the other mould section during the closing thereof onto the stationary mould. The mounting for each segment conveniently comprises a guide rod fixed to the stationary mould section and upon which the segment is slidable radially inwardly and outwardly relative to said section, whilst the resilient means conveniently comprises coil springs acting between the stationary mould section and the segment to bias it radially outwardly thereof; abutment means being provided for limiting the radially outward movement of the segment under the influence of said springs.

The actuating means for moving the segments radially inwardly may take the form of a frusto-conical skirt depending from the movable mould section and engageable with correspondingly shaped radially outer peripheral surfaces of the mould segments, whereby axial closing movement of the movable mould section towards the stationary mould section will provide uniform and simultaneous radially inward movement of the mould segments to fully enclose the uncured tire.

In a modification of the foregoing form of the invention, the movable mould section is carried by a carrier plate and includes resilient means biasing the mould section away from the plate for a purpose which will be further explained herein. In this modification, the segments and said co-operating means are mounted on the carrier plate whereby the movable mould section and the segments are movable independently of one another relative to the carrier plate.

Other features of the invention will become apparent from the following description of the parts, principles and elements thereof given herein solely by way of example with

reference to the accompanying drawings wherein like reference numerals refer to like parts throughout the several views and wherein:

Figure 1 is a transverse cross-sectional view through a segmental mould constructed in accordance with the invention;

Figure 2 is a top plan view on the line 2-2 of Figure 1;

Figure 3 is an enlarged exploded perspective view of one mould segment showing the guide rod and biasing means;

Figures 4 - 6 are cross-sectional views of one side of the mould of Figure 1 showing part of typical structure within which the mould may be installed and illustrating a series of steps in the closing cycle of the mould sections;

Figures 7 - 9 illustrate a series of steps similar to those shown in Figures 4 - 6 but in a modified embodiment of the mould structure;

Figure 10 is a cross-sectional view of one side of a mould incorporating a modified form of resilient biasing means for the segments; and

Figure 11 is a view of the line XI-XI of Figure 10.

Referring first of all to the embodiment illustrated in Figures 1 to 6, the subject segmental mould is essentially comprised of two opposed annular mould sections 10 and 12 and a plurality of mould segments 14 arranged in an annulus between the mould sections 10 and 12. In this embodiment, the two mould sections constitute an upper movable mould section 10 and a lower stationary mould section 12 and six mould segments 14 are mounted on said stationary mould section 12 for movement radially inwardly and outwardly relative thereto.

As will be known to those skilled in the art, the interior surfaces of the two opposed sections 10-12 are utilized for moulding those surfaces of the tire which extend from the bead to the shoulder region thereof, whilst the mould segments 14

are utilized for moulding the tread region of the tire. Thus, in the radially innermost position of the tread moulding segments 14 and with the opposed mould sections 10-12 closed together to their maximum extent, the mould provides a continuous enclosure for moulding the exterior surface of a tire, whilst in the radially outermost position of the mould segments they are located for total disengagement from the moulded tire facilitating its removal from the mould, as will be further explained herein.

In this embodiment, each tread moulding segment 14 is carried by the lower stationary mould section 12 for true radial sliding movement relative thereto as aforesaid, and there is also provided resilient biasing means (See Figures 2 and 3) biasing said segments 14 radially outwardly of said mould section 12 towards their radially outermost position; radially inward movement of the mould sections 14 taking place against the biasing action of the resilient means. More specifically, each segment 14 is mounted for sliding movement upon a guide rod 16 whilst a plurality of coil compression springs 18 act between each segment 14 and the stationary mould section 12 to bias the segment 14 radially outwardly.

It will be seen from the drawings and particularly from Figure 3, that the lower stationary mould section 12 is provided with an annular extension radially outwardly of the actual mould surface, said extension being in the form of a flat annular plate 20 extending to the radially outer periphery of the stationary mould section. A plurality of abutment means in the form of solid metal stops 22 are secured around the radially outer periphery of said annular plate 20 to define an annular groove of channel-shaped transverse cross-section between each said stop 22 and a should r 24 forming the radially inner side wall of said groov .

One said stop 22 is associated with each tread moulding segment 14 so that, in the present embodiment wherein six tread moulding segments are utilized, six corresponding stops 22 are circumferentially spaced around the radially outer periphery of the stationary mould section 12. The aforesaid guide rod 16 upon which each said tread moulding segment 14 is mounted, is rigidly secured between the shoulder 24 and the stop 22 and passes through a radially extending bore 26 in the segment 14, whereby the segment may slide radially inwardly and outwardly between the shoulder 24 and the stop 22 with the lower surface of the segment resting upon the surface 20 of the groove to prohibit pivotal movement of the segment 14 about the rod 16.

As illustrated, four additional bores 28 are provided in each segment 14, two on each side of the rod-receiving bore 26, for receiving the coil compression springs 18 which bias the segment 14 radially outwardly from the stationary mould section 12. Each such coil compression spring extends between two coaxially telescopically mounted captive pins, one of which is provided with an axial extension 30 projecting out of its associated bore 28 on the radially inner side of the segment to bear against the shoulder 24. The radially outer end of each said bore 28 is screw-threaded to receive an adjusting screw 32 bearing upon the head 34 of the other pin, whereby precompression may be applied to the compression spring 18 located in the bore 28. It may also be noted that, in order to facilitate sliding movement of each segment 14 upon its rod 16, a collar 36 is frictionally fitted within the rod-receiving bore 26 in the segment 14; said collar 36 containing a captive ball race bearing upon the cylindrical outer surface of the rod 16 and providing an extremely low friction bearing for the segment 14. The remainder of the segment is of generally conventional form having a

conventional tread moulding pattern P formed on its radially inner surface for engagement with the tread region of the uncured tire, whilst the radially outer surface 40 of the segment is of frusto-conical form for engagement by the radially inner surface of an annular frusto-conical skirt 42 depending downwardly from the movable upper mould section 10.

Thus, axial closing movement of the upper mould section 10 towards the lower mould section 12 will cause the radially inner surface of said skirt 42 to be brought into contact with the radially outer surfaces 40 of the segments 14, which, in their initial positions, are located at their radially outermost positions under the influence of the coil springs 18. Further closing movement of the movable mould section 10 towards the stationary mould section 12 will cause the skirt 42 and the outer surfaces 40 of the segments 14 to co-operate with a camming action forcing the segments radially inwardly relative to the mould sections against the action of the compression springs 18 until, in a fully closed position, the axially inner surface 44 of the upper movable mould section 10 contacts the top surface 46 of the segment 14, the segments then being in their radially innermost positions with their lower ends abutting against the shoulder 24.

Conversely, opening movement of the mould sections 10-12 permits the tread moulding segments 14 to be biased radially outwardly under the influence of the compression springs 18 as the movable mould section 10 retreats axially from the stationary mould section 12 until such time as the segments 14 have reached their radially outermost positions abutting against their respective stops 22.

The segmental mould thus described, is of extremely simple and economical manufacture and is extremely compact since

the actuating means for both radially inward and outward movement of the tread moulding segments is contained more or less within the peripheral confines of the upper and lower mould sections 10-12. Such a compact design of segmental mould enables it to be readily installed within a conventional moulding press without modification thereto, such as the well-known Bag-O-Matic* press, which is generally used for the moulding and curing of cross-ply tires. The conventional mould halves may be easily removed from such a Bag-O-Matic* press and the subject segmental mould readily installed in their place, whereby such press is adapted for the moulding of radial-ply tires, as will be explained herein.

As is known, radial-ply tires are brought to the final moulding and curing stage in partially-shaped form rather than in the cylindrical form in which cross-ply tires are generally inserted into the curing press. Figures 4 to 6 of the drawings illustrate a series of steps in the closing of a press within which the subject segmental mould is installed and which may be utilized for final shaping, moulding and curing of a radial-ply tire, and wherein part of the conventional press structure namely, the curing bag 50 and its upper and lower seating rings 52-54, are shown in somewhat diagrammatic form.

As a first step, the partially-shaped green tire T is laid upon the lower stationary mould section 12, the curing bag rings 52-54 are brought together and the bag 50 is inflated to retain the green tire in the position shown in Figure 4. The press actuating mechanism (not shown) is then operated to close the press, which in its final closing movement brings the upper movable mould section 10 towards the lower stationary mould section 12 in a truly axial direction, whereby the skirt 42 can engage the radially outer surfaces 40 of the mould segments 14, in the manner shown in Figure 5.



* Bag-O-Matic is a trademark of The McNeil Machine and Engineering Company, Akron, Ohio, U.S.A.

Continued closing movement of the press will close all of the mould segm nts 14 simultaneously radially inwardly towards the tread region of the green tire until they make simultaneous contact therewith, at the same time as th upper movable mould section 10 contacts and deforms the upper side wall of the green tire into the position shown in Figure 6. When the press halves are fully closed, the mould is also closed to provide a complete enclosure for the green tire, at which time the usual curing cycles may be commenced, it being understood of course that the subject mould sections are mounted in the press upon heatable platens, whereby the green tire may be cured under heat and pressure as desired.

When the curing cycle is complete, the press halves are opened permitting the mould segments 14 to move radially outwardly away from the taead region of the cured tire under the influence of their compression springs 18. Thus, a true radially outward movement of the mould segments 14 away from the moulded tread region is accomplished and there is no danger of tearing of the tread rubber. After complete opening of the press halves, the curing bag 50 is deflated and the rings 52-54 separated axially, at wh ch time the cured tire may be removed from the mould and passed either to final inspection, or, if necessary, to a post cure inflation stage.

Figures 7 to 9 of the drawings show a modification of the subject segmental mould, wherein the movable mould section 10 is itself carried upon a carrier plate 60 and spaced therefrom under the action of resilient biasing means 62. Such an arrangement may be necessary in order to ensure accurate setting of the tire beads upon the bead seats of the respective mould sections 10-12 as will be apparent from the following description. In such an arrangement, the carrier plate 60 is fixedly secured to the

upper press half (not shown), whereby the upper mould section 10 may be carried by and with the press half during its opening and closing movement. Specifically, the mounting for the upper mould section 10 upon the carrier plate 60 comprises a plurality of axially extending guide shafts 64 circumferentially spaced around the periphery of the carrier plate and a plurality of corresponding bearings 66 in the upper mould section for sliding movement upon respective said guide shafts 64. Also, a plurality of coil compression springs 62 are located to act between the carrier plate 60 and the upper mould section 10; such springs being compressible to permit the mould section 10 to move upwardly into contact with the carrier plate 60 during final closing movement of the mould sections 10-12 towards one another.

In this arrangement, the skirt 42 is carried by the plate 60 by suitable brackets 68 so as to be movable by and with the plate 60 independent of the mould section 10.

The remainder of the mould arrangement is identical with that hereinbefore described, thereby offering the same advantages of simple and compact structure whereby it may be readily installed in a conventional press without modification thereto, such as the Bag-O-Matic* press referred to hereinbefore. To install a partially-shaped green tire of radial-ply construction in the press, the two rings 52-54 carrying the curing bag 50 are both moved axially upwardly relative to the lower stationary mould section 12 in such manner that the curing bag 50 may be expanded into the interior of the green tire T so that it may be held in a somewhat "floating" condition after the automatic loaders have been removed; such a position being shown in Figure 7. It will be realized that the initial insertion of the green tire in its "floating" position is but optional in this modified embodiment and the tire may, if d sired, be initially placed directly onto the stationary mould



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section 12 substantially as described with reference to the first embodiment herein.

Following the location of the green tire T on the curing bag 50, closing movement of the press halves is initiated whereby the upper side wall region of the green tire is contacted first by the movable mould section 10; the whole assembly of curing bag 50 and tire T carried thereby then being pressed downwardly into contact with the lower stationary mould section 12. At the same time, the tread moulding segments 14 are moved radially inwardly towards the tread region of the tire, as shown in Figure 8. As will be seen from Figure 8, the mould sections 10-12 are brought into their final spaced relation axially with respect to one another setting the tire beads before the tread moulding segments 14 have completed their radially inward movement. As mentioned hereinbefore, the frusto-conical skirt 42, which actuates the segments 14, is carried by the carrier plate 60 so that further continued axial movement of the carrier plate 60 towards the lower stationary mould section 12 will cause further radially inward movement of the mould segments 14 towards the tread region of the tire, whilst, at the same time, the compression springs 62 acting between the upper mould section 10 and the carrier plate 60 are compressed. The fully closed condition of the press is shown in Figure 9 wherein the carrier plate 60 is in its final abutting position against the axially outer surface of the upper mould section 10 and the segments 14 are in their radially innermost positions.

It will be noted in the foregoing embodiments that the tread moulding segments 14 are designed and shaped for moulding only the tread portion of a tire without encroaching onto the shoulder regions thereof. However, in certain low profile tires having more pronounced crowning across the shoulder and tread

regions, it may be desirable to mould said regions by the segments 14 whereby the parting lines of the mould will be displaced axially outwardly of one another as compared with the arrangement described hereinbefore and as shown in Figures 1 to 9.

Thus, in the modification illustrated in Figures 10 and 11, the segments 14 are adapted to mould not only the tread region proper of the tire but also a part of the shoulder regions thereof. Such an arrangement necessitates a modification to the mounting and resilient biasing means for the segments as will be more fully described herein whereby it will be observed that the mounting comprises a separate base extension to each segment 14.

Referring to the said Figures 10 and 11, the mould is again essentially comprised of an upper movable mould section 10 and a lower stationary mould section 12 with a plurality of segments 14 slidable in a true radial direction relative to the mould sections 10-12. The co-operating means for actuating radially inner movement of the segments 14 is again constituted by the skirt 42 which in this embodiment and as may also be adopted in the preceding embodiments includes internal hollow chambers 42a for heating means such as steam.

Each segment 14 is mounted for true radial sliding movement relative to the mould section 12 by means of a pair of parallel guide rods 72 screw threadedly secured at their radially inner ends 74 to the mould section 12 so as to extend radially outwardly thereof. The mould section 12 is again provided with guide surface 20 for the segments 14 and such surface is relieved as at 76 to provide two parallel radially extending channels for slidably receiving respective bearing blocks 78 secured to the base of the segment 14; said blocks 78 running upon respective said rods 72.

As is clearly shown in Figure 11, the periphery of the

mould section 12 is squared to receive a plate 80 constituting abutment means limiting radially outward movement of the bearing blocks 78 and also providing additional support and mounting for the heads of the rods 72. Resilient biasing means for the segments 14 in the form of a coil compression spring 82 is located around each guide rod 72 acting between the mould section 12 and the radially inner side of the associated bearing block 78 so as to bias the segments 14 radially outwardly relative to the mould section 12.

Each bearing block 78 includes an upwardly projecting key 84 located in a corresponding recess 86 in the undersurface of its segment 14 and is fixedly secured thereto such as by screws 88. Each block 78 is provided with a central bore within which is frictionally retained a ball race 90. Said block 78 with its enclosed ball race 90 is dimensioned for sliding engagement within a said channel 76 about a respective guide rod 72 whereby the segment 14 may slide to and fro on said guide rods in response to the various relative movements between the mould sections 10-12 substantially in the manner hereinbefore described with reference to the preceding embodiments.

Although the foregoing description with respect to all of the embodiments herein concerns the mounting of the segments 14 upon a lower stationary half of a curing press, it should be appreciated that the subject segmental mould may be inverted whereby the mould section 10 and the skirt 42 may be installed on the lower stationary half of a press whilst the co-operating mould section 12 together with its segments 14 may comprise an upper movable mould section carried by the upper movable press half.

The embodiments of the invention in which an exclusive property or privilege is claimed, are defined as follows:

1. A segmental tire mould adapted for use in a tire curing press of the type which normally utilizes upper and lower mould halves each of which includes half of the sidewall and tread mould ing sections of the mould comprising, in combination, a carrier plate adapted for attachment to said curing press in place of said upper mould half; opposed annular mould sections relatively movable towards and away from one another for moulding the bead and sidewall regions of a tire; mounting means securing one of said mould sections to said carrier plate permitting limited axial movement relative thereto; first resilient means biasing said one mould section away from said carrier plate; a plurality of mould segments arranged in an annulus between said one mould section and the other said mould section for moulding the tread region of said tire; guide means contained substantially within the peripheral confines of and slidably mounting said segments on said other mould section and permitting radial movement of said segments relative to said other mould section; second resilient means biasing said segments radially outwardly of said other mould section; stop means limiting the extent of radially outward movement of said segments and co-operating means operative to move said segments radially inwardly against the bias of said second resilient means during movement of said mould sections towards one another, said co-operating means permitting radially outward movement of said segments under the influence of said second resilient means during movement of said mould sections away from one another.

2. A mould as claimed in claim 1 wherein said mounting means comprises a plurality of axially extending shafts circumferentially spaced around said carried plate and a plurality of corresponding bearings on said one mould section.

3. A mould as claimed in claim 1 wherein said guide means comprises a plurality of circumferentially spaced rods extending radially outwardly of said other mould section and bearings carried by each said segment mounted for sliding movement on a respective said rod; said stop means being disposed at the radially outer end of each said rod.

4. A mould as claimed in claims 1, 2 or 3 wherein said co-operating means comprises an annular frusto-conical skirt on said carrier plate having a frusto-conical radially inner surface co-operable with a corresponding radially outer surface on each said segment.

5. A mould as claimed in claims 1, 2 or 3 wherein said first resilient means comprises a plurality of compression springs acting between said one mould section and said carrier plate.

6. A mould as claimed in claim 3 wherein said second resilient means comprises a plurality of compression springs acting between said other mould section and said segments.

7. A mould as claimed in claim 6 wherein adjustment means are associated with each said springs for varying the degree of resilient bias thereof.

8. A mould as claimed in either one of claims 6 or 7 wherein said resilient means comprises a plurality of spaced compression springs acting as aforesaid being spaced circumferentially of each said segment and located internally thereof on either side of said guide rod.

9. A mould as claimed in either one of claims 6 or 7 wherein said resilient means comprises a coil compression spring disposed about said guide rod acting as aforesaid directly upon said bearing exteriorly of said segment.



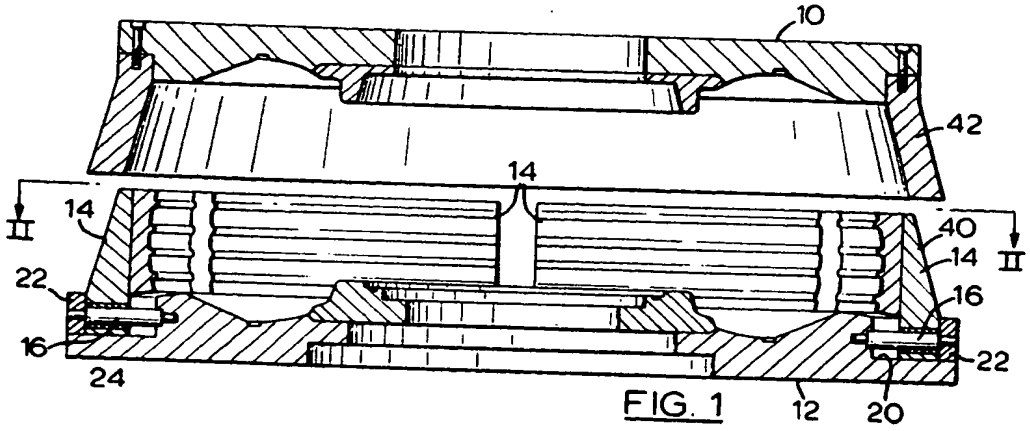


FIG. 1

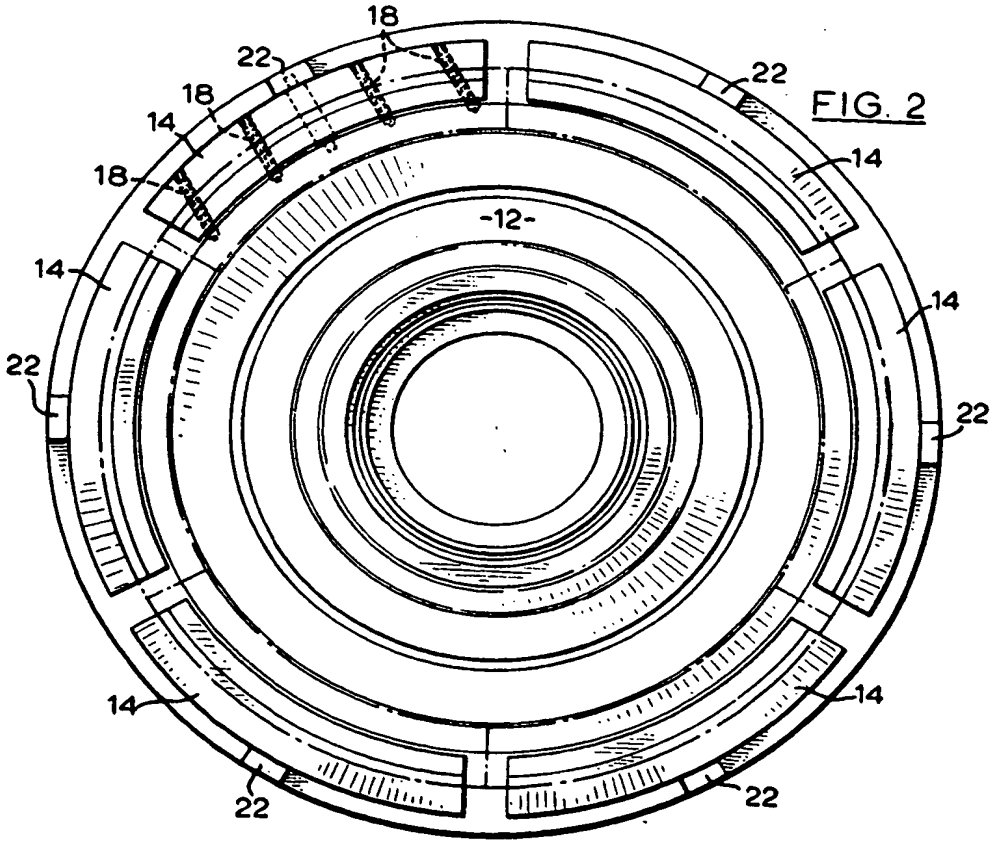


FIG. 2

C. Harold Ricks Associates

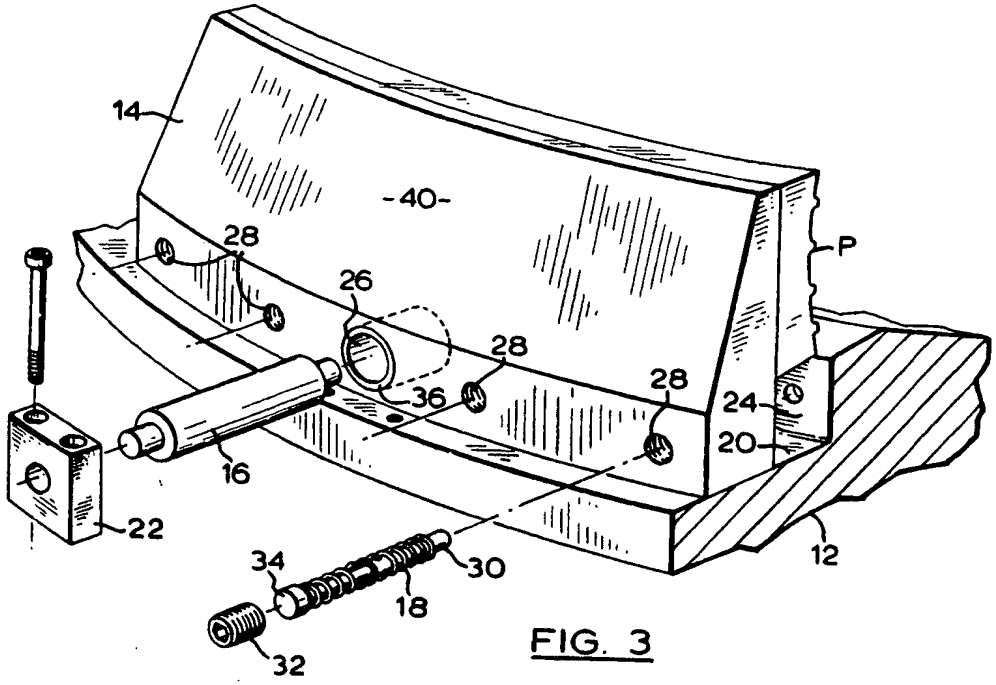


FIG. 3

C. Harold Rickes Associates

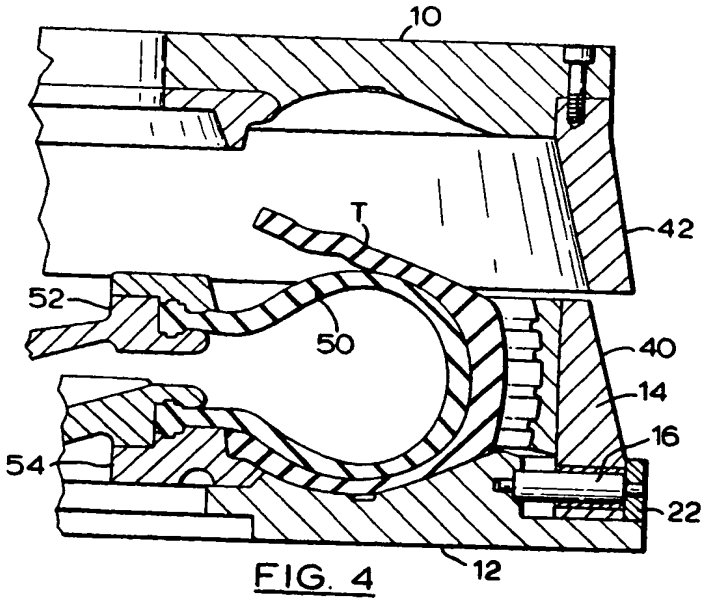


FIG. 4

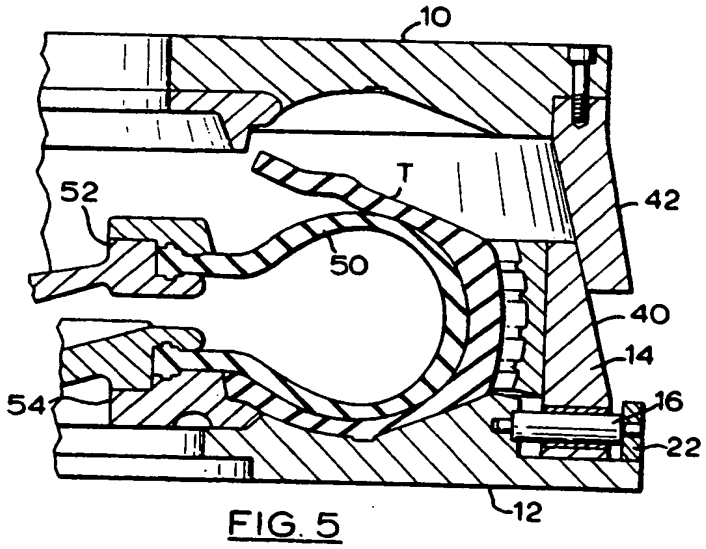


FIG. 5

C. Harold Ricks Associates

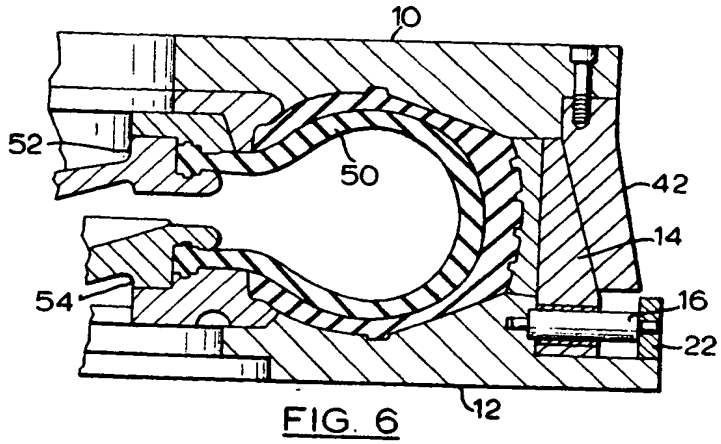


FIG. 6

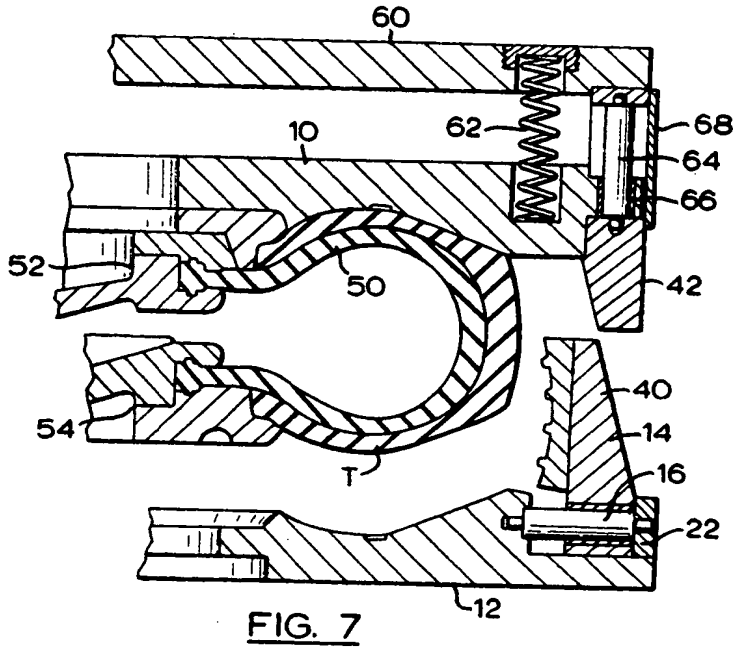


FIG. 7

C. Harold Rukes Associates

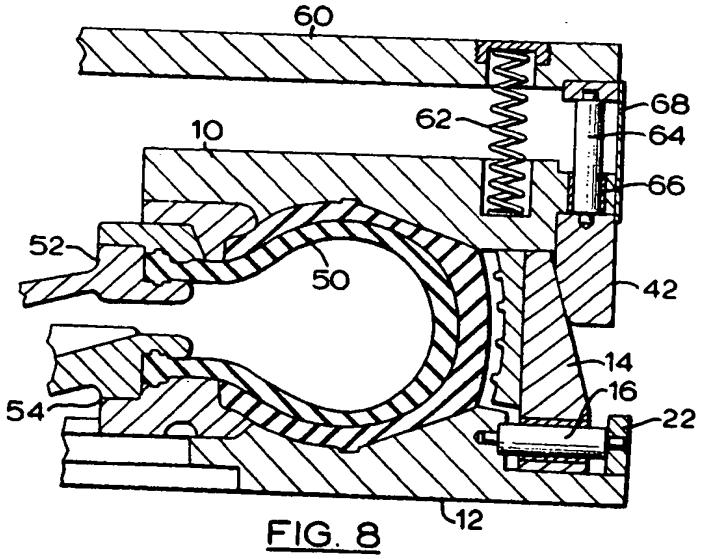


FIG. 8

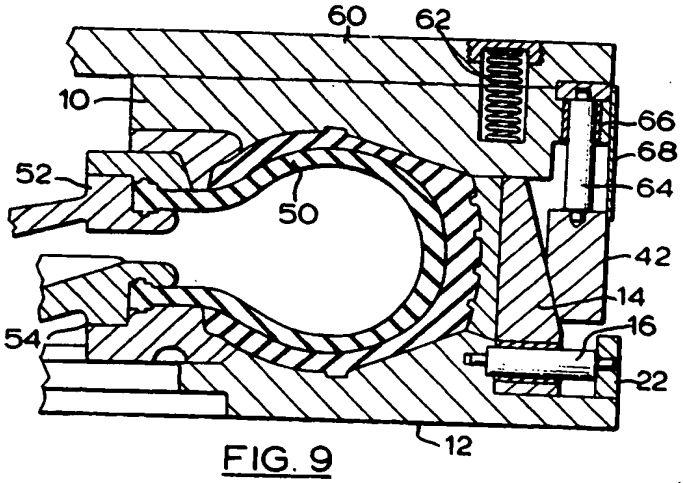


FIG. 9

C. Harold Ruhs Associates

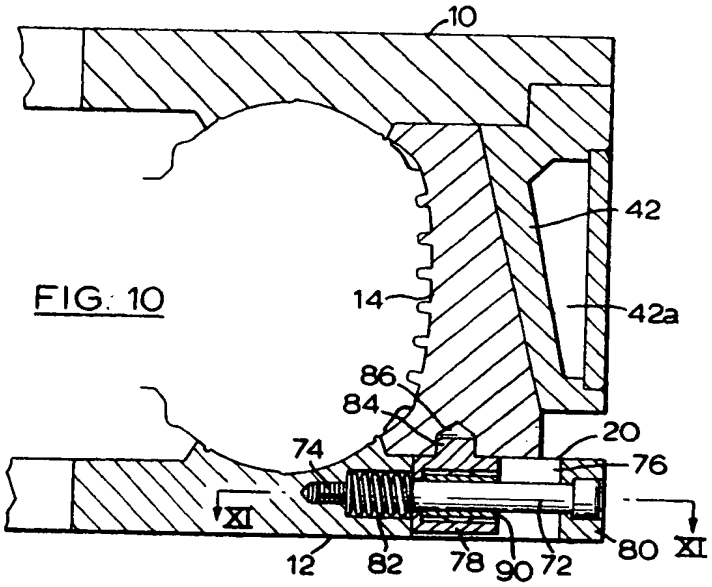


FIG. 10

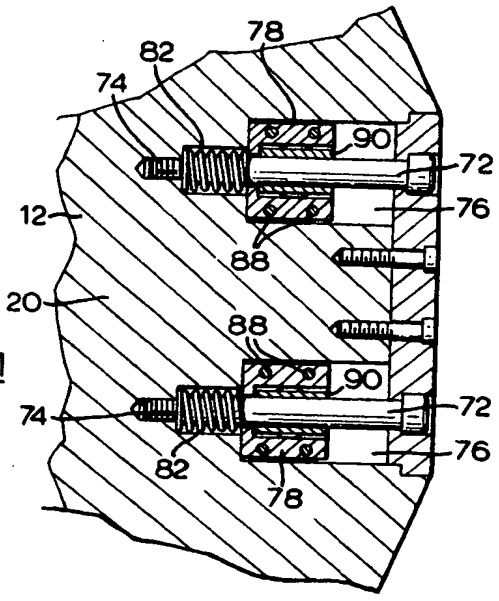


FIG. 11

C. Harold Richer Associates